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ELECTRIC IMPULSE SIGNALING SYSTEM

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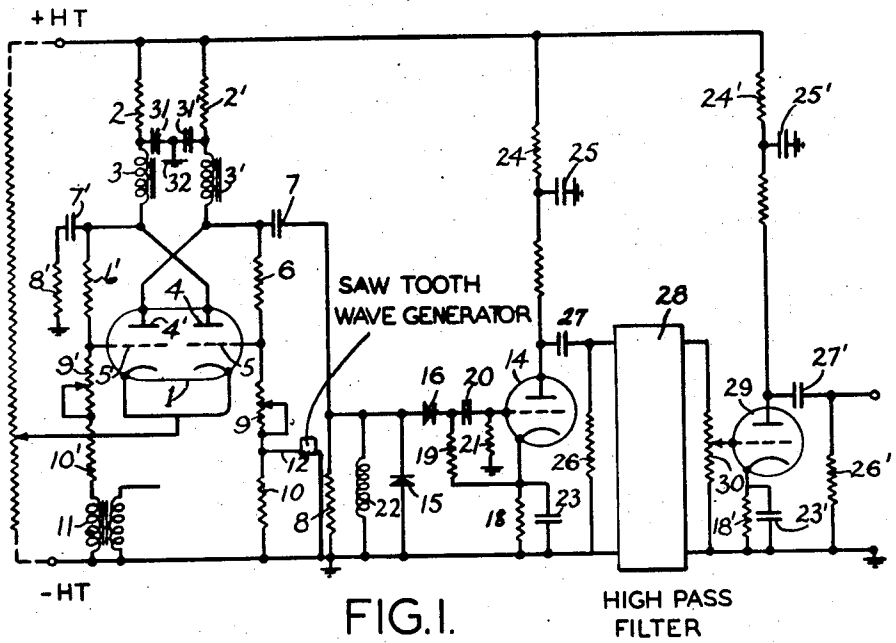

FIG. 1.
TRANSMITTER

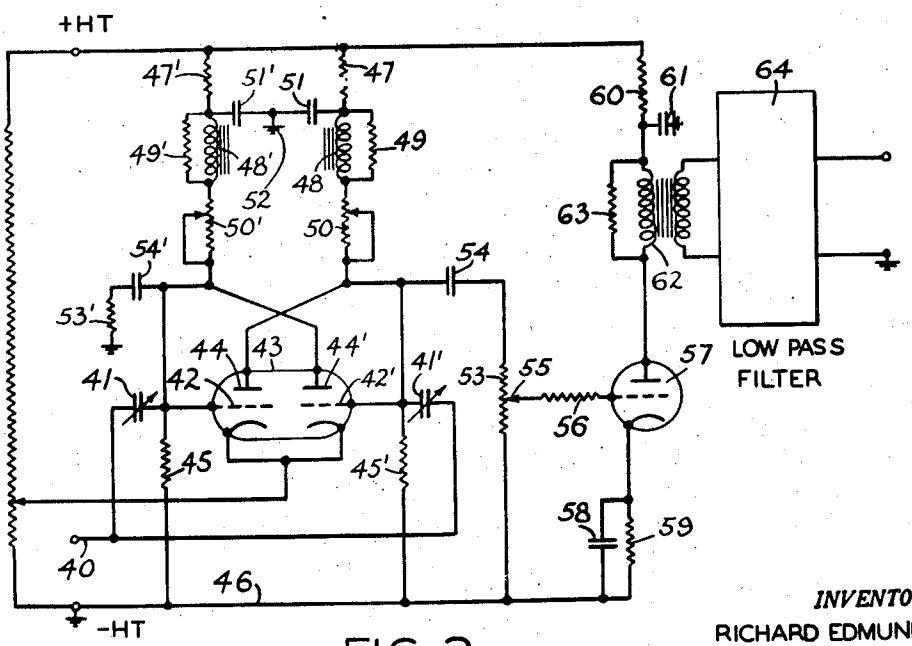

FIG. 2.
RECEIVER

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ELECTRIC IMPULSE SIGNALING SYSTEM

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The present invention refers to electric impulse signaling systems wherein the messages are transmitted by means of impulses whose individual duration is a function of the instantaneous amplitude of the waves constituting the modulation signal at the moment this impulse is transmitted, and its main object is to ensure greater amplitude of signaling impulses.

The transmitting and receiving circuits provided in the present invention for such impulse signaling are characterized particularly by means for using, at the transmitting as well as at the receiving end, only one of the two series of rectangular signals or impulses generated by double stability trip devices, which ensures to the sharp impulses derived from these rectangular signals and amplified a greater amplitude than if the two series of rectangular signals were used for signaling purposes.

Furthermore, both at the transmitting and at the receiving end, means such as choke inductances inserted in the plate circuit of the double stability devices are provided to increase the amplitude of the rectangular signals generated, hence of the impulse derived from these signals.

The invention will be explained in detail in the following description given in connection with the accompanying drawing, in which:

Fig. 1 shows a transmitting circuit for impulse signaling of the type defined above, incorporating features of the invention; and

Fig. 2 shows a receiving circuit incorporating features of the invention, suitable particularly for use in conjunction with the transmitting circuit shown in Fig. 1.

With reference to Fig. 1, a double stability sudden trip device 1 in the form of a double triode is shown with exactly balanced plate, grid and filament circuits. In other words, the filament supply (not shown for greater simplicity of the drawing) is for example provided in well known manner with an electric mid-point connection, while the filaments are heated in a series circuit. (Alternatively, a single filament might be employed.) The plate supply is obtained from the wire +HT by means of two identical circuits comprising, for example, two equal value resistances 2—2', themselves in series with two choke inductances 3—3' connected respectively to the plates 4 and 4' of the double triode 1. The plates 4 and 4' are respectively connected to the grids 5' and 5 across two equal value resistances 6—6' on the one hand and to the ground on the other across equal capacities and resistances 7—7' and 8—8'. The ground to which resistances 8 and 8'

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are connected is that placed on wire —HT. The two grids 5—5' are respectively connected to the wire —HT by adjustable resistances 9—9' in series with fixed resistances 10—10' to provide a biasing of the grids. In the biasing connection of the grid 5' is inserted the secondary winding of a transformer 11 to whose primary terminals is applied the modulation wave, for example a speech wave. Between the fixed resistance 10 and the adjustable resistance 9 of the connection of the other grid 5 is applied the control voltage of the trip device, as indicated at 12, this control voltage coming, for example, from a saw-tooth oscillation generating circuit.

With such an arrangement, the control voltage applied at 12 will cause the generation, by the double stability device 1, of rectangular oscillations whose duration will be a function of the instantaneous amplitude of the modulation signal applied at 11. The rectangular signals coming from the plate 4 increase or decrease the charge on the condenser 7' which charge has been put there by the high tension supply and which can leak off through the resistance 8'. This charge controls the voltage at the grid of tube 4' and hence the triggering action. The rectangular signals coming from the plate 4' increase or decrease the charge on the condenser 7 which charge has been put there or which leaks off through the resistance 8, the coil resistance 22, and the rectifier 15. The circuit constituted by the condenser 7 and the coil 22 converts the rectangular pulse into two sharp short impulses defining the beginning and the end of the rectangular pulse. These pulses are applied to an arrangement comprising the two rectifying elements 15 and 16. Rectifier 15 shunts one of said two sharp short impulses to ground; rectifier 16 passes the other of said impulses. The pulses passed and shunted depend on the respective polarity. These two rectifying elements are connected in relative polarity opposition with regard to the inductance 22, the currents which they pass flowing over a resistance 18 in the cathode circuit of the amplifying tube 14. The amplifying tube 14 is provided with a grid-cathode circuit comprising a resistance 19 in series with a condenser 20 and a resistance 21 connected to ground. The plate voltage of tube 14 is taken from the wire +HT across a resistance 24 connected to ground across a condenser 25.

The output circuit of the amplifying tube 14 consists as usual of a resistance 26 in shunt between the plate and the ground, a condenser 27 being inserted in the connection of the plate to

the resistance. The signaling voltage at the terminals of this resistance is applied over a high-pass filter 28 to eliminate the low frequency modulation products that may have been amplified, and the output is taken at the terminals of this filter to another amplifying stage which reverses the sense of the impulses which are applied to it over an adjustable tap of a resistance 30 connected to the output terminals of the filter so that the impulses transmitted shall be positive. This amplifying stage 29 comprises the same circuit elements as the amplifying stage 14 and these elements are designated by the same reference numbers with the addition of a prime (').

In order to obtain proper operation of the circuit described, it is necessary to adjust the resistances 9 and 9' to suitable values, this adjustment being made individually. Furthermore, the electrical symmetry of the plate circuit is enhanced by two equal capacities 31—31' connected in series with a mid-ground connection 32 in shunt to the lower terminals of resistances 2 and 2'. The inductances 3 and 3' produce a partial peaking of the anode currents and increase the amplitude of the rectangular impulses supplied by the trip device 1. Otherwise the device 1 operates in well known manner as a controlled multi-vibrator.

Moreover, the fact that use is made of only one series of rectangular signals in the output of the double stability device 1 for obtaining the start and end impulses of the signals ensures, upon amplification of said impulses by the tube 14, a much greater amplitude than if the two series of rectangular signals were used and the resultant impulses amplified.

The impulses transmitted are received by a receiver comprising the usual high and medium frequency stages (not shown), and then are applied to the terminals 40 of the circuit of Fig. 2 and thence across adjustable capacities 41 and 41' to the grids 42 and 42' of a double triode double stability device 43 whose filaments are supplied symmetrically in known suitable manner (not shown) and whose plates 44—44' are interconnected with the grids 42' and 42 in the manner already described with reference to Figure 1. Equal grid biasing resistances 45 and 45' are connected between the grids 42 and 42' and the ground wire 46 while the plates 44 and 44' are connected to the wire +HT through fixed resistances 47 and 47', self-inductances 48 and 48' in parallel with the fixed resistances 49—49' and adjustable resistances 50—50' respectively. The electrical symmetry of this plate supply is here further ensured by two equal condensers 51—51' connected in series between the ends of the fixed resistances 47—47' with their mid-point grounded at 52.

The trip device 43 will thus supply in its output circuit two series of rectangular pulse signals under the control of the impulses received, once the condensers 41 and 41' have been adjusted to suitable values. One series of these impulses will be grounded directly, over a resistance 53' and a condenser 54' while the impulses of the other series are applied to the resistance 53, of the same value as resistance 53', connected to ground at the common wire 46, over a condenser 54 of the same value as the condenser 54'. However, this resistance 53 has an adjustable tap 55 whereby the level of the outgoing impulses can be adjusted to apply them over the resistance 56 to the grid of an amplifying tube 57.

The cathode circuit of this amplifying tube 57 comprises the usual parallel combination condenser 58-resistance 59 to ground while its plate supply is furnished from the wire +HT over a fixed resistance 60 one end of which is grounded as shown over a capacity 61 and the primary winding of an output transformer 62, this winding being shunted by a resistance 63. The secondary of this output transformer 62 is connected to a receiver such as a telephone receiver (not shown) over a low-pass filter 64 which filter eliminates the high frequencies remaining in the rectangular signal pulses.

At the receiver, as at the transmitter, a greater amplitude of the outgoing impulses will be obtained thanks to the suppression of the positive impulses as also on account of the presence of the choke inductances 48—48', which may consist of two windings of a dust core toroidal coil.

Various modifications and adaptations can be made in the arrangement described within the scope of the present invention.

What is claimed is:

1. A pulse duration modulating circuit arrangement for producing successive pairs of pulses having a time spacing corresponding to the instantaneous amplitude of a modulating wave, comprising a double stability trigger device, means for generating a control signal wave repetitive at the desired pulse repetition frequency, means to apply said control wave to said device so as to cause one portion of said control wave to cause said double stability device to assume one condition of stability and to cause another portion of said control wave to place said device in condition for assuming its other condition of stability, a source of modulation, means to apply voltage from said source to said device, and means to cause said device to assume its other condition of stability a predetermined time from the time at which it has been conditioned by said second mentioned means, said predetermined time being controlled by the magnitude of the voltage from said source.

2. A pulse duration modulating circuit arrangement for producing successive pairs of pulses having a time spacing corresponding to the instantaneous amplitude of a modulating wave, comprising a pair of electron discharge means arranged as a double stability trigger device, means for generating a control wave repetitive at the desired pulse repetition frequency, means to apply said control wave to a control electrode of one of said electron discharge means so as to cause one portion of said control wave to cause said double stability device to assume one condition of stability and to cause another portion of said control wave to place said device in condition for assuming its other condition of stability, a source of modulation, means to apply voltage from said source to a control electrode of the other of said electron discharge means, and means to cause said device to assume its other condition of stability a predetermined time from the time at which it has been conditioned by said second mentioned means, said predetermined time being controlled by the magnitude of the voltage from said source.

3. A pulse duration modulating circuit arrangement for producing successive pairs of pulses having a time spacing corresponding to the instantaneous amplitude of a modulating wave according to claim 2 wherein the frequencies in the voltage from said source of modulation are

much less than the repetition rate of said control wave.

4. A pulse duration modulating circuit arrangement for producing successive pairs of pulses having a time spacing corresponding to the instantaneous amplitude of a modulating wave according to claim 5 wherein said last mentioned means comprises a connection from one anode over a condenser and a resistance to ground, a connection from the other anode over a second condenser and a second resistance to ground, an inductive reactance shunted across said second resistance, a rectifier shunted across said inductive reactance and also across said resistance, and an output circuit connected across said inductive reactance.

5. A pulse modulating arrangement for producing successive pairs of pulses having a time spacing corresponding to the instantaneous amplitude of a modulating wave comprising a pair of electron discharge means connected in a double stability trigger circuit, means for generating a control wave, means for applying said control wave to said trigger circuit so as to cause one portion of said control wave to cause said trigger circuit to assume one condition of stability and to cause another portion of said control wave to place said trigger circuit in condition for assuming its other condition of stability, a source of modulation waves of lower frequencies than those in said control wave, and means to cause said trigger circuit to assume its other condition of stability a predetermined time from the time at which it has been conditioned by said second

mentioned conditioning means, said predetermined time being controlled by the magnitude of the voltage of said modulation wave.

6. A pulse modulating circuit arrangement according to claim 5 wherein each of said electron discharge means includes an anode, and further comprising a high tension supply connected to each anode, and an inductive choke connected in the lead between said high tension supply and the anode of said trigger circuit to differentiate the output pulses produced in said trigger circuit.

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